

**COMPACT OPTICAL TRANSCEIVER MODULE HAVING HOUSING WITH IMPROVED
COUPLING MECHANISM AND ASSEMBLY METHOD THEREOF**

BACKGROUND OF THE INVENTION

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The present invention relates generally to a laser-based data communication interconnect apparatus for effecting optical data transfer and, more particularly, to a compact optical transceiver apparatus having an improved housing with an improved coupling mechanism and method of assembly.

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Optical transceiver modules are known in the data transmission field for effecting bidirectional data transmission, whereby electrical signals are converted to optical signals and vice versa. In operation, a transmitter unit of the optical transceiver module functions to convert incoming electrical signals to corresponding optical signals. Conversely, incoming optical signals are converted by the optical transceiver module's receiving unit into corresponding electrical data signals. These units are typically mounted on a circuit host card that is normally associated with a host computer, input/output device, switch, or other peripheral device.

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In general, transceiver module compactness for achieving space saving concerns is important particularly in situations wherein many optical transceiver modules are closely mounted on a data system for increasing port density. Such concerns become even more pronounced when it is desired to satisfy established as well as emerging standards relating to size and form factor.

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However, because these optical transceiver modules are relatively expensive to manufacture and relatively fragile in construction, it is important to avoid damaging them during the assembly process. Typically, during optical transceiver module assembly a heat sink cover is manually placed over and on a carrier base that supports a printed circuit board having expensive and compactly arranged electro-optical components of the optical transceiver module mounted thereon. Unless significant care is exercised in the assembly process due to the tight tolerances between such components as required by compactness constraints potential damage may occur. Further, there is a concern for being able to easily reopen and close the optical transceiver module for inspection and/or repair of the internal circuit board and the components carried thereon without damaging them. Moreover, there is a desire to not only make such transceivers easy to assemble, but to do so in a manner which does not compromise the integrity of effective electromagnetic interference (EMI) shielding.

Without the ability to effectively and efficiently assemble such optical transceiver modules, given the compactness constraints for meeting existing and emerging standards, by avoiding damage to their components, the potential value of providing low-cost and reliable optical transceivers is diminished.

Given the above, it will be appreciated, that there is a desire to provide for: optical transceiver modules that have compact constructions satisfying existing and emerging standards

regarding size and form factor; optical transceiver modules wherein the assembly process can be carried out in a manner that reduces the likelihood of components being damaged; optical transceiver modules that are less costly to assemble; optical transceiver modules having the ability to protect interior components of the transceiver during repair and/or reconstruction; and, optical transceiver modules that achieve the foregoing without compromising desired EMI shielding.

SUMMARY OF THE INVENTION

It is, therefore, a principal aspect of the present invention to make provision for a compact optical transceiver module that has a relatively simple construction requiring few components for effecting ease of assembly and disassembly of the optical transceiver module.

It is, therefore, another principal aspect of the present invention to make provision for a compact optical transceiver module of the above type that minimizes the potential for damage to costly components of the optical transceiver module during assembly and/or disassembly thereof.

It is yet another aspect of the present invention to make provision for a compact optical transceiver module that has a relatively simple construction that facilitates safe and easy enclosing of expensive and fragile components requiring relatively compact space considerations during the assembly process.

It is, therefore, another principal aspect of the present invention to make provision for a compact optical transceiver module that is economical to manufacture and assemble.

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It is, therefore, another principal aspect of the present invention to make provision for a compact optical transceiver module of the foregoing types that allow the optical transceiver module to meet existing and emerging standards as to size and form factor.

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In regard to achieving the foregoing aspects, the present invention makes provisions for an optical transceiver that comprises: a carrier; a cover couplable to cooperating structure of a distal portion of the carrier to define a transceiver enclosure; an electro-optical assembly supported in the enclosure; and, a coupling mechanism coupled to the cooperating structure for allowing pivoting motion of the cover relative closed and opened conditions relative to the enclosure about a pivoting axis offset from the transceiver.

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In an illustrated embodiment the coupling mechanism allows the cover to move to the closed condition without interference with upstanding components of the electro-optical assembly.

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Further consistent with achieving the foregoing aspects and improving on the prior art the present invention makes provisions for the coupling mechanism allowing the cover to move to the closed condition without applying loading to upstanding

components of the electro-optical assembly which might be sufficient to damage such components.

Further consistent with achieving the foregoing aspects, the present invention makes provisions for a method of assembling components of an optical transceiver. The method comprises the steps of: providing a carrier; providing a cover joinable together with the carrier to define an enclosure therebetween; providing an electro-optical subassembly within the enclosure and supported by the carrier, providing a coupling mechanism on one of the carrier or the cover; providing a cooperating structure on the other of the carrier and cover; and, assembling the cover to the carrier so that when the coupling mechanism is joined to the cooperating structure, the cover pivots in a controlled path between opened and closed conditions about an axis remote from the transceiver, whereby interference of the cover or the electro-optical assembly is substantially minimized or eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, reference is now made to the following detailed description of a preferred embodiment of the present invention illustrated in the accompanying drawings in which:

Fig. 1 is a schematic plan view of an optical transceiver of the present invention mounted on a host circuit card of a data transfer system of the present invention;

Fig. 2 is a schematic view of the optical transceiver in an assembled condition;

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Fig. 3 is a schematic view similar to Fig.2, but illustrating the transceiver partially in a disengaged/engaged position;

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Fig. 4 is a schematic view similar to Fig. 3, but illustrating the heat sink cover removed from the carrier; and,

Fig. 5 is an enlarged and fragmented perspective view of the coupling mechanism in the position depicted in Fig. 3.

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DETAILED DESCRIPTION

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Figs. 1-5 illustrate one preferred embodiment of an optical transceiver module 10 made according to the principles of the present invention and illustrated as being mounted in a host data transfer system 12.

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A first or proximal end portion 14 of the optical transceiver module 10 is to be coupled directly to a card edge connector 16 that is covered in a metal shroud 18 and is otherwise connected to a network adapter card 20 housed within the confined space 22 formed by a host data transfer system 12. The data transfer system can be a mid-range computer system commercially available from International Business Machines

Corporation, Armonk, NY. Other types of data transfer or communication systems are contemplated for use with the optical transceiver module of the present invention, such as input/output devices or other peripheral devices. The optical transceiver module 10 is otherwise slidably received within one of a plurality of elongated slots 24 formed in the network adapter card 20 in a manner to be described. A suitable connector end portion 26 at the distal end of the optical transceiver module 10 is releasably coupled to a data transfer system bezel or wall 28 through threaded fastener members 29 attached to a flange after being inserted into a system access opening 30. The connector end portion 26 has ports (not shown). The connector end portion 26 is to be coupled to a suitable push-pull duplex "SC" connector (not shown) in a known manner. While a duplex "SC" type connection is envisioned, a comparable end portion cooperable with other known connectors, such as for example, a single "SC" connector, a "LC" connector, or a "MT-RJ" connector can be used.

Essentially, the optical transceiver module 10 comprises, a housing assembly 32 including a carrier member 34 being matable to a heat dissipating apparatus or heat sink cover or member 36; and, an electro-optical subassembly 38 that is substantially enclosed by and between the cover and carrier members. The carrier member 34 and heat sink cover 36 can be made from a variety of suitable materials that are selected to ensure generally uniform heat dissipation yet maintain effective electromagnetic interference (EMI) shielding. The carrier member 34 has, preferably, an integral parallelepiped construction and can be fabricated from any number of suitable materials that are

generally used for optical transceivers. Ideally, the carrier member 34 is made of a low-cost, die-cast metal, such as aluminium or zinc, or a plastic with a metallized coating. An upstanding peripheral wall 40 surrounds and, in part, defines an enclosure 42 (Figs.3-5), which is a space between the carrier member 34 and the heat sink cover 36 for receiving the electro-optical assembly 38. The upper surface of the wall 40 engages a bottom wall of the heat sink cover member 36 to maintain effective EMI shielding. The wall 40 does not extend across the proximal end of the carrier member 34 and this allows an end portion 43 of a printed circuit board 44, forming a part of the electro-optical assembly 38, to protrude out of the optical transceiver module. A pair of spaced apart and generally parallel pedestals 46 (Fig. 5) is raised from the carrier floor for purposes of providing a datum surface for the bottom surface of the heat sink cover. A pair of L-shaped card mounting members 48, only one of which is shown extends along each longitudinal marginal edge of the optical transceiver module. Each of the mounting members 48 defines a corresponding guiding channel 50 that is adapted to receive the edges 52 (Fig. 1) defining the slot 24. A row of longitudinally spaced apart spring members 54 is attached to a bottom surface of each of the mounting members 48. The spring members 54 serve to flexibly and resiliently bias the optical transceiver module to the network adapter card 20 as well as permit bi-directional sliding motion of the optical transceiver module to the network adapter card. As noted above, the printed circuit board member 44 is sized and configured to be mounted within the enclosure 42 and has the end portion 43 extended slightly from the housing assembly 32 as illustrated for

interconnection to the connector 16. The printed circuit board 44 may comprise any suitable type of rigid or flexible type substrate. A known type of card edge connector, not shown, is at the end of the circuit board so as to register with the connector 16 in a known manner. The printed circuit board member 44 is formed with a pair of generally parallel and spaced apart cutouts 56 (Fig.5), each of which receives a respective one of the pedestals. As is known, this electrical connection is effective for interconnecting the electro-optical assembly with the data transfer assembly.

Because of the heat generated due to operation of the electro-optical assembly 38, it is important to maximize heat transfer therefrom. For instance, the laser driver chip 58 tends to operate at relatively higher temperatures than some of the other components on the printed circuit board. One effective technique is to establish a thermal conductive path therefrom to the inside wall portion of the heat sink cover. While the laser driver chip is shown in an upstanding relationship from the printed circuit board, it will be appreciated that other components have upstanding relationships, such as the known type of electro-optical transmitter subassembly (TOSA) unit 60 and an electro-optical receiver subassembly (ROSA) unit 62. Both the TOSA and ROSA are wired to the laser driver chip 58 mounted on the printed circuit board 44.

The heat sink cover 36 facilitates heat dissipation from operation of the electro-optical assembly 38. In this embodiment, the heat sink cover 36 is generally thin and

rectangular in overall shape. A plurality of heat dissipating elements or fins 64 project upwardly from an external surface thereof; for purposes of clarity only a portion of the fins are illustrated in Fig.1, but are more completely illustrated in Figs. 2-5. The fins 64 are deployed in a generally parallel and spaced apart relationship in the manner illustrated. The fins 64 are generally uniformly spaced apart relative to each other to allow air flow therebetween for an effective convective cooling relationship. Of course, the present invention contemplates that the fins 64 can have other configurations, spacings and heights. In fact, the fins need not substantially cover the upper surface area of the heat sink cover. The proximal end of the heat sink cover has a generally thin protective lip 68 extending over and beyond the protruding end portion 43 of the printed circuit board.

The present invention includes one preferred embodiment of a coupling mechanism 70 that comprises a pair of coupling arms, coupling elements 72 adjacent a distal end portion of the heat sink cover 36. Each of the coupling elements 72 is, preferably, formed integrally on opposing longitudinal edges of the heat sink cover 36 and is adapted to cooperate with cooperating structure 73 on a distal end of the carrier. A distal end portion 74 of each of the coupling elements 72 faces away and downwardly from the protective lip 68 for cooperation with corresponding elongated and curved slots 76 formed in sidewalls 40. The slots 76 also form part of the coupling mechanism 70. In this regard, each of the slightly curved slots 76 is sized and configured to allow for relative pivotal movement of the heat sink cover with

respect to the carrier when the coupling elements are inserted therein. Essentially, the slots 76 effect a camming action. The generally arcuate shape of the slots effects a slight pivoting action of the heat sink cover in a controlled path about a pivot axis 78 in response to the coupling elements being inserted thereinto. Because of the camming provided by the slots 76 about the offset pivot axis 78 a controlled opening and closing motion of the cover relative to the carrier and electro-optical assembly is easily effected. This accomplished with relatively substantially fewer components. Accordingly, the heat sink cover is guided into the desired closed condition covering the enclosure without imparting loading forces; especially lateral loading that might damage upstanding components of the electro-optical assembly. As a consequence, during assembly and/or disassembly of the heat sink cover the potential of damage to such upstanding components is greatly diminished if not eliminated by the coupling mechanism of the present invention. Also, the width of each of the slots 76 has a slightly tapered configuration thereby facilitating an even more secure interconnection with the complementary sized and shaped coupling elements 72. Such an interconnection minimizes compromise of EMI shielding integrity. In the broader context of the present invention, it will be appreciated that the coupling elements could be on the carrier and the slots 76 provided in the heat sink cover.

It will be noted in Fig. 3 that the linear distance 79 the end portion 43 protrudes the heat sink cover is selected to be slightly less than the length of arcuate motion of the coupling

elements 72 within each of the slots 76, in order to permit the heat sink cover pivotally moving without interfering with the circuit board 44 while the cover is being assembled or disassembled. In addition, the heat sink cover has a pair of
5 straddle members 80 straddling and engaging longitudinal marginal edges of the circuit board 44 and act to engage the carrier end for effecting stoppage of the motion of the coupling elements 72 relative to the slots 76 during assembly/disassembly. A tight locking engagement of the coupling elements 72 within the slots
10 76 is effected (Fig. 2) and as a result, effective maintenance of the EMI shielding is retained.

The embodiments and examples set forth herein were presented to best explain the present invention and its practical
15 application and to thereby enable those skilled in the art to make and use the invention. However, those skilled in the art will recognize that the foregoing description and examples have been presented for the purposes of illustration and example only. The description set forth is not intended to be exhaustive or to
20 limit the invention to the precise forms disclosed. Many modifications and variations are possible in light of the above teachings without departing from the spirit and scope of the appended claims.